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Technical Report Series on the Boreal Ecosystem-Atmosphere Study (BOREAS)

Forrest G. Hall and David E. Knapp, Editors

Volume 124 BOREAS TE-1 SSA Soil Lab Data

T. Nerbas and D. Anderson

National Aeronautics and Space Administration

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BOREAS TE-1 SSA Soil Lab Data

Tim Nerbas, Darwin Anderson

Summary

This data set was collected by TE-1 to provide a set of soil properties for BOREAS investigators in the SSA. The soil samples were collected at sets of soil pits in 1993 and 1994. Each set of soil pits was in the vicinity of one of the five flux towers in the BOREAS SSA. The collected soil samples were sent to a lab, where the major soil properties were determined. These properties include, but are not limited to, soil horizon; dry soil color; pH; bulk density; total, organic, and inorganic carbon; electric conductivity; cation exchange capacity; exchangeable sodium, potassium, calcium, magnesium, and hydrogen; water content at 0.01, 0.033, and 1.5 MPascals; nitrogen; phosphorus; particle size distribution; texture; pH of the mineral soil and of the organic soil; extractable acid; and sulfur. The data are stored in tabular ASCII text files.

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1. Data Set Overview

1.1 Data Set Identification

BOREAS TE-01 SSA Soil Lab Data

1.2 Data Set Introduction

This data set was collected by the Terrestrial Ecology (TE)-01 team to provide a set of soil properties for BOReal Ecosystem-Atmosphere Study (BOREAS) investigators in the Southern Study Area (SSA). The soil samples were collected at sets of soil pits. Each set of soil pits was in the vicinity of one of the five flux towers in the SSA. These soil samples were sent to a lab, where the major soil properties were determined. These properties include, but are not limited to, soil horizon; dry soil color; pH; bulk density; total, organic, and inorganic carbon; electric conductivity; cation exchange capacity; exchangeable sodium, potassium, calcium, magnesium, and hydrogen; water content at 0.01,

0.033, and 1.5 MegaPascals; nitrogen; phosphorus; particle size distribution; texture; pH of the mineral soil and of the organic soil; extractable acid; and sulfur. These data are stored in American Standard Code for Information Interchange (ASCII) text files.

1.3 Objective/Purpose

The objective of this study was to develop a complete characterization of all soil types at the BOREAS SSA sites. This data set was collected by the TE-01 team to provide a set of soil properties for BOREAS investigators in the SSA. The soil samples were collected at sets of soil pits. Each set of soil pits was in the vicinity of one of the five towers in the SSA. These soil samples were sent to a lab, where the major soil properties were determined.

1.4 Summary of Parameters

The soil survey samples were examined for the visual characteristics: horizon designation, color, structure, and depth. The pH, bulk density, total carbon (TC), organic carbon (OC), and inorganic carbon (IC) values were measured on the general soil survey samples. Detailed analyses were performed on pit soil samples representing the soil types at each tower, which included the measurements listed above and: TC, IC, electric conductivity (EC), cation exchange capacity (CEC), exchangeable Na+, K+, Ca₂+, Mg₂+, and H+; soil moisture retentions (0.01, 0.033, and 1.5 MPascals); total N; total P; particle size fractions (coarse, medium, fine, and very fine sand, silt, and clay); and texture.

1.5 Discussion

A general survey of soils was performed at each SSA site in a 1-km² area with the tower in the center. Soils were sampled with a frequency that allowed the production of a 1:5,000 map. The soil maps represent a different data set.

A more thorough examination of the soil was performed on a series of soil pits (four or five) dug on a transect that covered the dominant soil types in each SSA site. In the summer of 1993, the Old Aspen (OA), Old Jack Pine (OJP), Young Jack Pine (YJP), and Fen sites were surveyed. The Old Black Spruce (OBS) site was surveyed in the summer of 1994. The soil survey was performed by an experienced soil surveyor, using all methods for measuring soil characteristics that are routinely used in soil surveys. The survey provides a data base that forms the basic measurements that are necessary for a complete ecological study of the boreal forests.

The Northern Study Area (NSA) soil survey field work was performed by the BOREAS TE-20 team, but the analysis of the soil samples were performed by the same lab and methods as these SSA soil samples.

1.6 Related Data Sets

Agriculture Canada Central Saskatchewan Vector Soils Data

CanSIS Regional Soils Data in Vector Format

BOREAS Regional Soils Data in Raster Format and AEAC Projection

BOREAS Soils Data over the SSA in Raster Format and AEAC Projection

BOREAS TE-20 NSA Soil Lab Data

BOREAS TE-20 Soils Data over the NSA-MSA and Tower Sites in Vector Format

BOREAS TE-20 Soils Data over the NSA-MSA and Tower Sites in Raster Format

BOREAS TE-01 Soils Data over the SSA Tower Sites in Raster Format

BOREAS TGB-12 Soil Carbon and Flux Data of NSA-MSA in Raster Format

BOREAS TGB-12 Soil Carbon Data over the NSA

2. Investigator(s)

2.1 Investigator(s) Name and Title

Darwin W. Anderson Professor University of Saskatchewan

2.2 Title of Investigation

General Soil Survey for Primary Sites in SSA (OA, OBS, OJP, YJP, Fen)

2.3 Contact Information

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3. Theory of Measurements

A number of different soil properties were measured for use by BOREAS investigators. The theory and methods used to measure these properties are as follows:

- Bulk Density: An intact known volume of soil is removed, dried, and weighed; the density can then be calculated.
- TC: All types of carbon will be combusted into carbon dioxide (CO₂) in a flow of oxygen (O₂) at 2,500 °F.
- IC: IC reacts with acid producing CO₂, which is quantified through titration.
- OC: Equals measured TC minus measured IC.
- EC: The ability of the soil to carry an electrical current, which is indicative of salt content.
- CEC: If a soil is washed with one cation (Ba), and the other cations are leached, the first cation fills the exchange sites of the leached cation, and equals the soil's CEC.
- Exchangeable Cations: Equals the quantity of cations in the leachate after they have been exchanged off the soil.
- Soil Moisture Retentions: Equals the amount of water in soils under a suction equal to 0.01, 0.033, and 1.5 MPascals (i.e., field moisture 10th, saturated moisture, and wilting moisture, respectively).
- Soil Size Fractions: Clay and silt are measured based on the principle that the speed at which a particle will fall in water will depend on the size of the particle.

4. Equipment

4.1 Sensor/Instrument Description

- Bulk density: 10 cm diameter tube, 10 cm long.
- TC: LECO CR12 Carbon Determinator 781-600
- CEC and exchangeable cations: Cation concentrations were measured by atomic adsorption-Perkin Elmer 3100.

Equipment used in other procedures is listed in the references and manuals listed in Section 17.

4.1.1 Collection Environment

None given.

4.1.2 Source/Platform

Not applicable.

4.1.3 Source/Platform Mission Objectives

Not applicable.

4.1.4 Key Variables

Soil Horizon Soil Color (Dry) pH Bulk Density Total Carbon Organic Carbon

Inorganic Carbon

Electric Conductivity

Cation Exchange Capacity

Exchangeable Sodium

Exchangeable Potassium

Exchangeable Calcium

Exchangeable Magnesium

Exchangeable Hydrogen

Water Content at a pressure of 0.01 MPascals (0.1 atmospheres)

Water Content at a pressure of 0.033 MPascals (0.33 atmospheres)

Water Content at a pressure of 1.5 MPascals (15 atmospheres)

Nitrogen

Phosphorus

Percentage of Very Coarse Sand

Percentage of Coarse Sand

Percentage of Medium Sand

Percentage of Fine Sand

Percentage of Very Fine Sand

Percentage of Total Sand

Percentage of Total Silt

Percentage of Total Clay

Texture

Horizon Number

pH of the Mineral Soil (CaCl₂)

pH of the Organic Soil (CaCl₂)

pH of the Mineral Soil (H₂O)

pH of the Organic Soil (H₂O)

Extractable Acid

Sulfur

4.1.5 Principles of Operation

None given.

4.1.6 Sensor/Instrument Measurement Geometry

Not applicable.

4.1.7 Manufacturer of Sensor/Instrument

None given.

4.2 Calibration

Calibration information was provided for the following instruments:

TC: LECO 501-034 12%

Dry soil colors were measured according to the Munsell color chart.

All other standards were prepared in the laboratory from pure analytical compounds and tested against National Institute of Standards and Technology (NIST) standards.

4.2.1 Specifications

None given.

4.2.1.1 Tolerance

None given.

4.2.2 Frequency of Calibration

None given.

4.2.3 Other Calibration Information

None.

5. Data Acquisition Methods

Bulk Density: Cylinders of known volume and weight are pressed into the soil and filled with soil in its natural state. The soil and cylinder are dried at 105 °C and weighed. The soil weight is then calculated and divided by the cylinder volume (Manual on Soil Sampling and Methods of Analysis).

- TC: Measured by combustion of dried soil samples in a LECO CR12 Carbon Determinator (LECO Corporation Application Bulletin form no. 203-601-071).
- IC: Measured through digestion in acid, and evolved CO₂ is measured directly as carbonic acid in a two-endpoint titration (Tiessen et al., 1983).
- OC: Equals measured TC minus measured IC.
- Total Nitrogen and Phosphorus: Digestion in H₂SO₄ and H₂O₂ (Thomas et al., 1967). Products NH₄+ and P were measured colorimetrically by the ammonia-salicylate method (Technicon, 1973) and acid-molybdate blue method (Murphy and Riley, 1962), respectively.

Electrical conductivity and pH: Standard laboratory meter.

- CEC: The cations on the exchange are replaced with barium (Ba), which is then exchanged off the soil with NH₄ and the amount of Ba is measured (p. 54, Manual on Soil Sampling and Methods of Analysis).
- Exchangeable Cations: Measured in leachate after Ba has exchanged them off the soil; Na+, K+, Ca₂+, Mg₂+ by atomic absorption and H+ by back titration with HCl to pH 5.1 (p. 83, Manual on Soil Sampling and Methods of Analysis).
- Soil Moisture Retentions: Pressure plate extraction (p. 45, Manual on Soil Sampling and Methods of Analysis).
- Soil Size Fractions: Pipette method (p. 6, Manual on Soil Sampling and Methods of Analysis).

6. Observations

6.1 Data Notes

The table below lists soil classification (by order and subgroup), site location, soil pit number, and BOREAS site location of soil pits in this study. This information enables the user to spatially link soils data from this study to the TE-01 Soils Data over the NSA-MSA and Tower Sites in Raster Format and BOREAS Soils Data over the SSA in Raster Format and AEAC Projection. See TE-01 soils data documentation and Soil Classification Working Group (1998) for detailed description of soil classification. See also TE-20 Soils Report.

Site	Pit				
location	number	Order	Subgroup	BOREAS Site	Location
OA	1	LUVISOL	OGL	SSA-90A-FLXTR	9TE01-SOLO1
OA	2	LUVISOL	OGL	SSA-90A-FLXTR	9TE01-SOLO2
OA	3	LUVISOL	OLG	SSA-90A-FLXTR	9TE01-SOLO3
OA	4	LUVISOL	OGL	SSA-90A-FLXTR	9TE01-SOLO4
OA	5	LUVISOL	OGL	SSA-90A-FLXTR	9TE01-SOLO5
OJP	1	BRUNISOL	OEB	SSA-OJP-FLXTR	9TE01-SOLO1
OJP	2	BRUNISOL	OEB	SSA-OJP-FLXTR	9TE01-SOLO2
OJP	3	BRUNISOL	EB	SSA-OJP-FLXTR	9TE01-SOLO3
OJP	4	BRUNISOL	?	SSA-OJP-FLXTR	9TE01-SOLO4
YJP	1	BRUNISOL	EB	SSA-YJP-FLXTR	9TE01-SOLO1
YJP	2	BRUNISOL	EB	SSA-YJP-FLXTR	9TE01-SOLO2
YJP	3	BRUNISOL	OEB	SSA-YJP-FLXTR	9TE01-SOLO3
FEN	1a			SSA-FEN-FLXTR	9TE01-SOLO1

FEN	1b		SSA-FEN-FLXTR	9TE01-SOLO2
FEN	1c		SSA-FEN-FLXTR	9TE01-SOLO3
FEN	1d		SSA-FEN-FLXTR	9TE01-SOLO4
FEN	1e		SSA-FEN-FLXTR	9TE01-SOLO5
FEN	2a		SSA-FEN-FLXTR	9TE01-SOLO6
FEN	2b		SSA-FEN-FLXTR	9TE01-SOLO7
FEN	2c		SSA-FEN-FLXTR	9TE01-SOLO8
FEN	2d		SSA-FEN-FLXTR	9TE01-SOLO9
FEN	2e		SSA-FEN-FLXTR	9TE01-SOLO10
FEN	3a		SSA-FEN-FLXTR	9TE01-SOLO11
FEN	3b		SSA-FEN-FLXTR	9TE01-SOLO12
FEN	3c		SSA-FEN-FLXTR	9TE01-SOLO13
FEN	3d		SSA-FEN-FLXTR	9TE01-SOLO14
FEN	3e		SSA-FEN-FLXTR	9TE01-SOLO15
OBS	1		SSA-OBS-FLXTR	9TE01-SOLO1
OBS	2_1	Peat	SSA-OBS-FLXTR	9TE01-SOLO21
OBS	2_2	Peat	SSA-OBS-FLXTR	9TE01-SOLO22
OBS	2_3	Peat	SSA-OBS-FLXTR	9TE01-SOLO23
OBS	3_1	Peat	SSA-OBS-FLXTR	9TE01-SOLO31
OBS	3_2	Peat	SSA-OBS-FLXTR	9TE01-SOLO32
OBS	3_3	Peat	SSA-OBS-FLXTR	9TE01-SOLO33
OBS	3_4	Peat	SSA-OBS-FLXTR	9TE01-SOLO34

SOILDEV = Soil development (soil classification).

Order Subgroup

Brunisolic

EDYB Eluviated Dystric Brunisol

GLEDYB Gleyed Eluviated Dystric Brunisol

EEB Eluviated Eutric Brunisol

GLEEB Gleyed Eluviated Eutric Brunisol

Gleysolic

OHG Orthic Humic Gleysol
RHG Rego Humic Gleysol
OG Orthic Gleysol
FEG Ferric Gleysol

OLG Orthic Luvic Gleysol HULG Humic Luvic Gleysol

Luvisolic

OGL Orthic Gray Luvisol
DGL Dark Gray Luvisol
GLGL Gleyed Gray Luvisol
GLDGL Gleyed Dark Gray Luvisol

Organic

TYF Typic Fibrisol
MEF Mesic Fibrisol
TF Terric Fibrisol

TMEF Terric Mesic Fibrisol

HYF Hydric Fibrisol
TYM Typic Mesisol

FIM	Fibric Mesisol
TM	Terric Mesisol
TFIM	Terric Fibric Mesisol
THUM	Terric Mesic Humisol
TH	Terric Humisol
TFIH	Terric Fibric Humisol
TMEH	Terric Mesic Humisol
Cryosolic	
OSC	Orthic Static Cryosol
RSC	Regosolic Static Cryosol
OTC	Orthic Turbic Cryosol
RTC	Regosolic Turbic Cryosol
FIOC	Fibric Organic Cryosol
MEOC	Mesic Organic Cryosol
HUOC	Humic Organic Cryosol
TFIOC	Terric Fibric Organic Cryosol
TMEOC	Terric Mesic Organic Cryosol
THUOC	Terric Humic Organic Cryosol

Note: EB is described as Degraded Eutric Brunisol.

6.2 Field Notes

No important problems were encountered.

7. Data Description

7.1 Spatial Characteristics

7.1.1 Spatial Coverage

The general soil survey had soil profiles examined on a 100-m by 100-m grid system in a 1-km² area with the tower in the center at the SSA OA, OBS, OJP, YJP, and Fen sites. The soil pits from which the soil samples were collected fell within these areas. The tower flux sites are located in the SSA at the following North American Datum of 1983 (NAD83) coordinates:

	Longitude	Latitude
OBS	105.11779 W	53.98718 N
OJP	104.69203 W	53.91634 N
OA	106.19779 W	53.6289 N
YJP	104.64527 W	53.87581 N
Young Aspen (YA)	105.32313 W	53.65602 N

7.1.2 Spatial Coverage Map

None.

7.1.3 Spatial Resolution

These data represent point locations.

7.1.4 Projection

Not applicable.

7.1.5 Grid Description

Not applicable.

7.2 Temporal Characteristics

7.2.1 Temporal Coverage

In the summer of 1993, the OA, OJP, YJP, and Fen sites were surveyed. The OBS site was surveyed in the summer of 1994. The soil properties that were measured from the samples do not tend to change significantly with time. All measured parameters will change only over the long term, so any data could be valuable to generalize the soil characteristics of the area for many years in the future.

7.2.2 Temporal Coverage Map

None.

7.2.3 Temporal Resolution

The soil samples were collected at a certain point in time. However, the soil properties that were derived from the samples do not tend to change significantly with time.

7.3 Data Characteristics

7.3.1 Parameter/Variable

The parameters contained in the data files on the CD-ROM are:

Column Name ______ SITE NAME SUB SITE MEASUREMENT YEAR HORIZON START DEPTH END DEPTH DRY SOIL COLOR STRUCTURE DESCR SOIL PH BULK DENSITY PEAT DESCR TOTAL SOIL C CONTENT SOIL_ORG_C_CONTENT SOIL INORG C CONTENT ELECTRIC_CONDUCTIVITY CATION EX CAPACITY EXCHANGE SODIUM EXCHANGE POTASSIUM EXCHANGE CALCIUM EXCHANGE_MAGNESIUM EXCHANGE HYDROGEN WATER CONTENT 10KPA WATER CONTENT 33KPA WATER_CONTENT_1500KPA SOIL NITROGEN CONTENT SOIL_PHOSPHORUS_CONTENT VERY COARSE SAND COARSE SAND

MEDIUM_SAND
FINE_SAND
VERY_FINE_SAND
TOTAL_SAND
TOTAL_SILT
TOTAL_CLAY
SOIL_TEXTURE
CRTFCN_CODE
REVISION_DATE

7.3.2 Variable Description/Definition

The descriptions of the parameters contained in the data files onmthe CD-ROM are:

Column Name	Description
SITE_NAME SUB_SITE	The identifier assigned to the site by BOREAS, in the format SSS-TTT-CCCCC, where SSS identifies the portion of the study area: NSA, SSA, REG, TRN, and TTT identifies the cover type for the site, 999 if unknown, and CCCCC is the identifier for site, exactly what it means will vary with site type. The identifier assigned to the sub-site by
	BOREAS, in the format GGGGG-IIIII, where GGGGG is the group associated with the sub-site instrument, e.g. HYD06 or STAFF, and IIIII is the identifier for sub-site, often this will refer to an instrument.
MEASUREMENT_YEAR	The year in which the data were collected.
PIT	The pit identifier from which the sample was taken.
HORIZON	The soil horizon from which the sample was taken.
START_DEPTH	The start depth from the surface where the sample was collected.
END_DEPTH	The end depth from the surface where the sample was collected.
DRY_SOIL_COLOR	The Munsell color of the soil when it is dry.
STRUCTURE_DESCR	A description of the soil structure (e.g. amorphous, weakly decomposed, single grain).
SOIL_PH	The pH of the soil sample.
BULK_DENSITY	Bulk density of the soil sample.
PEAT_DESCR	A one word description of the peat (e.g. FIBRIC, HUMIC, MINERAL), for fen site only.
TOTAL_SOIL_C_CONTENT	The percent total carbon in the soil sample.
SOIL_ORG_C_CONTENT	The percent organic carbon in the soil sample.
SOIL_INORG_C_CONTENT	The percent inorganic carbon in the soil sample.
ELECTRIC_CONDUCTIVITY	The electric conductivity of the soil sample.
CATION_EX_CAPACITY EXCHANGE_SODIUM	The cation exchange capacity in the soil sample. The exchangeable sodium in the soil sample.
EXCHANGE_POTASSIUM	The exchangeable potassium in the soil sample.
EXCHANGE CALCIUM	The exchangeable calcium in the soil sample.
EXCHANGE_MAGNESIUM	The exchangeable magnesium in the soil sample.
EXCHANGE_HYDROGEN	The exchangeable hydrogen in the soil sample.

WATER_CONTENT_10KPA The water content of the soil in percent by weight of water held at 0.01 MegaPascals. WATER CONTENT 33KPA The water content of the soil in percent by weight of water held at 0.033 MegaPascals. WATER CONTENT 1500KPA The water content of the soil in percent by weight of water held at 1.5 MegaPascals. SOIL NITROGEN CONTENT The nitrogen content of the soil sample. The phosphorus content of the soil sample. SOIL_PHOSPHORUS_CONTENT VERY COARSE SAND The amount of very coarse sand in the soil sample. COARSE SAND The amount of coarse sand in the soil sample. MEDIUM SAND The amount of medium sand in the soil sample. FINE SAND The amount of fine sand in the soil sample. VERY FINE SAND The amount of very fine sand in the soil sample. The total amount of sand in the soil sample. TOTAL SAND TOTAL SILT The total amount of silt in the soil sample. The total amount of total clay in the soil TOTAL_CLAY sample. SOIL_TEXTURE The texture of the soil sample. CRTFCN CODE The BOREAS certification level of the data. Examples are CPI (Checked by PI), CGR (Certified by Group), PRE (Preliminary), and CPI-??? (CPI but questionable). The most recent date when the information in the REVISION_DATE referenced data base table record was revised.

The following information should help in describing the soil horizon codes:

Organic Horizons		
Horizon Code	Code Description	
0	This is an organic horizon developed mainly from mosses, rushes, and woody materials.	
Of	The fibric horizon is the least decomposed of all the organic soil materials. It has large amounts of well-preserved fiber that are readily identifiable as to botanical origin. A fibric horizon has 40% or more of rubbed fiber by volume and a pyrophosphate index of 5 or more. If the rubbed fiber volume is 75% or more, the pyrophosphate criterion does not apply.	
Om	The mesic horizon is the intermediate stage of decomposition with intermediate amounts of fiber, bulk density and water-holding capacity. The material is partly altered both physically and biochemically. A mesic horizon is one that fails to meet the requirements of fibric or humic.	
Oh	The humic horizon is the most highly decomposed of the organic soil materials. It has the least amount of fiber, the highest bulk density, and the lowest saturated water-holding capacity. It is very stable and changes very little physically or chemically with time unless it is drained. The humic horizon has less than 10% rubbed fiber by volume and a pyrophosphate index of 3 or less.	
LFH	These organic horizons developed primarily from leaves, twigs, woody materials, and a minor component of mosses under imperfectly to well-drained forest conditions.	

L	This is an organic horizon characterized by an accumulation of organic matter in which the original structures are easily discernible.
F	This is an organic horizon characterized by an accumulation of partly decomposed organic matter. The original structures in part are difficult to recognize. The horizon may be partly comminuted by soil fauna as in moder, or it may be a partly decomposed mat permeated by fungal hyphae as in mor.
Н	This is an organic horizon characterized by an accumulation of decomposed organic matter in which the original structures are indiscernible. This material differs from the F horizon by its greater humification chiefly through the action of organisms. It is frequently intermixed with mineral grains, especially near the junction with the mineral horizon.

Mineral Horizons

Mineral horizons are those that contain less than 30% organic matter by weight as specified for organic horizon.

Horizon Code	Code Description
A	 This is a mineral horizon or horizons formed at or near the surface in the zone of leaching or removal of materials in solution and suspension or of maximum in situ accumulation of organic matter, or both. Included are: horizons in which organic matter has accumulated as a result of biological activity (Ah); horizons that have been eluviated of clay, iron, aluminum, or organic matter, or all of them (Ae); horizons having characteristics of 1) and 2) above but transitional to underlying B or C (AB or A and B); horizons markedly disturbed by cultivation or pasture (Ap).
В	 This is a mineral horizon or horizons characterized by one or more of the following: an enrichment in silicate clay, iron, aluminum, or humus, alone or in combination (Bt, Bf, Bfh, Bhf, and Bh); a prismatic or columnar structure that exhibits pronounced coatings or stainings and significant amount of exchangeable Na (Bn); an alteration by hydrolysis, reduction, or oxidation to give a change in color or structure from horizons above or below, or both, and does not meet the requirements of 1) and 2) above (Bm, Bg).
С	This is a mineral horizon or horizons comparatively unaffected by the pedogenic processes operative in A and B, excepting (i) the process of gleying, and (ii) the accumulation of calcium and magnesium carbonates and more soluble salts (Cca, Csa, Cg, and C). Marl and diatomaceous earth are considered to be C horizons.

R	This is consolidated bedrock that is too hard to break with the hands or to dig with a spade when moist and that does not meet the requirement of a C horizon. The boundary between the R layer and overlying unconsolidated material is
	called a lithic contact.
W	This is a layer of water in Gleysolic, Organic, or Cryosolic soils. It is called a hydric layer in Organic soils.
Lower-Case Suf	ffixes
Horizon Code	Code Description
b	Buried soil horizon.
С	A cemented (irreversible) pedogenic horizon. The ortstein of a Podzol, and a layer cemented by calcium carbonate and a duripan are examples.
ca	A horizon with secondary carbonate enrichment where the concentration of lime exceeds that present in the unenriched parent material. It is more than 10 cm thick, and if it has a CaCO ₃ equivalent of less than 15 percent it should have at least 5 percent more CaCO ₃ equivalent than the parent material (IC). If it has more than 15 percent CaCO ₃ equivalent it should have 1/3 more CaCO ₃ equivalent than the IC. If no IC is present, this horizon is more than 10 cm thick and contains more than 5 percent by volume of secondary carbonates in concretions or soft, powdery forms.
сс	Cemented (irreversible) pedogenic concretions.
e	A horizon characterized by the eluviation of clay, iron, aluminum, or organic matter alone or in combination. When dry, it is usually higher in color value by 1 or more units than an underlying B horizon. It is used with A (Ae).
f	A horizon enriched with amorphous material, principally Al and Fe combined with organic matter. It usually has a hue of 7.5YR or redder or its hue is 10YR near the upper boundary and becomes yellower with depth. When moist, the chroma is higher than 3 or the value is 3 or less. It contains 0.6% or more pyrophosphate-extractable Al+Fe in textures finer than sand and 0.4% or more in sands (coarse sand, sand, fine sand, and very fine sand). The ratio of pyrophosphate-extractable Al+Fe to clay (less than 0.002 mm) is more than 0.05 and OC exceeds 0.5%. Pyrophosphate-extractable Fe is at least 0.3%, or the ratio of OC to pyrophosphate-extractable Fe is less than 20, or both are true. It is used with B alone (Bf), with B and h (Bhf), with B and g (Bfg), and with other suffixes. The criteria for "f" do not apply to Bgf horizons.
The following horimore than 5% OC.	zons are differentiated on the basis of OC content: Bf - 0.5% to 5% OC. Bhf -
Horizon Code	Code Description

g	A horizon characterized by gray colors, or prominent mottling, or both, indicative of permanent or periodic intense reduction. Chromas of the matrix are generally 1 or less. It is used with A and e (Aeg); with B alone (Bg); with B and f (Bfg); with B, h, and f (Bhfg); with B and t (Btg); with C alone (Cg); with C and k (Ckg); and several others. In some reddish parent materials, matrix colors of reddish hues and high chromas may persist, despite long periods of reduction. In these soils, horizons are designated as g if there is gray mottling or if there is marked bleaching on ped faces or along cracks.
Aeg	This horizon must meet the definitions of A, e, and g.
Bg	These horizons are analogous to Bm horizons but they have colors indicative of poor drainage and periodic reduction. They include horizons occurring between A and C horizons in which the main features are: (i) colors of low chroma, that is: chromas of 1 or less, without mottles on ped surfaces or in the matrix if peds are lacking; or chromas of 2 or less in hues of 10YR or redder, on ped surfaces or in the matrix if peds are lacking, accompanied by more prominent mottles than those in the C horizon; or hues bluer than 10Y, with or without mottles on ped surfaces or in the matrix if peds are lacking. (ii) colors indicated in (i) and a change in structure from that of the C horizons. (iii) color indicated in (i) and illuviation of clay too slight to meet the requirements of Bt; or accumulation or iron oxide too slight to meet the limits of Bgf. (iv) colors indicated in (i) and removal of carbonates. Bg horizons occur in some Orthic Humic Gleysols and some Orthic Gleysols.
Bfg, Bhfg, Btg, and others.	When used in any of these combinations the limits set for f, hf, t, and others must be met.
Bgf	The dithionite-extractable Fe of this horizon exceeds that of the IC by 1% or more. Pyrophosphate-extractable Al + Fe is less than the minimum limit specified for 'f' horizons. This horizon occurs in Fera Gleysols and Fera Humic Gleysols, and possibly below the Bfg of gleyed Podzols. It is distinguished from the Bfg of gleyed Podzols on the basis of the extractability of the Fe and Al. The Fe in the Bgf horizon is thought to have accumulated as a result of the oxidation of ferrous iron. The iron oxide formed is not associated intimately with organic matter or with Al, and it is sometimes crystalline. The Bgf horizons are usually prominently mottled, with more than half of the soil material occurring as mottles of high chroma.
Cg, Ckg, Ccag, Csg, Csag	When g is used with C alone, or with C and one of the lowercase suffixes k, ca, s, or sa, it must meet the definition for C and for the particular suffix.
h	A horizon enriched with organic matter. It is used with A alone (Ah); or with A and e (Ahe); or with B alone (Bh); or with B and f (Bhf).
Ah	A horizon enriched with organic matter that either has a color value at least one unit lower than the underlying horizon or contains 0.5% more OC than the IC, or both. It contains less than 17% OC by weight.
Ahe	An Ah horizon that has undergone eluviation as evidenced, under natural conditions, by streaks and splotches of differing shades of gray and often by platy structure. It may be overlain by a darker-colored Ah and underlain by a lighter colored Ae.

Bh	This horizon contains more than 1% organic carbon, less than 0.3% pyrophosphate-extractable Fe, and has a ratio of OC to pyrophosphate-extractable of 20 or more. Generally the color value and chroma are less than 3 when moist.
Bhf	Defined under 'f'.
j	Used as a modifier of the suffixes e, f, g, n, and t to denote an expression of, but failure to meet, the specified limits of the suffix it modifies. It must be placed to the right of and adjacent to the suffix it modifies. For example, Bfgj means a Bf horizon with weak expression of gleying; Bfjgj means a B horizon with weak expression of both 'f' and 'g' features.
Aej	An eluvial horizon that is thin, discontinuous, or slightly discernible.
Btj	A horizon with some illuviation of clay, but not enough to meet the limits of Bt. Btgj, Bmgj Horizons that are mottled but do not meet the criteria of Bg.
Bfj	A horizon with some accumulation of pyrophosphate-extractable Al and Fe but not enough to meet the limits of Bf. Bntj or Bnj Horizons in which development of solonetzic B properties is evident but insufficient to meet the limits for Bn or Bnt.
k	Denotes the presence of carbonate, as indicated by visible effervescence when dilute HCl is added. Most often it is used with B and m (Bmk) or C (Ck), and occasionally with Ah or Ap (Ahk, Apk), or organic horizons (Ofk, Omk).
m	 A horizon slightly altered by hydrolysis, oxidation, or solution, or all three, to give a change in color or structure, or both. It has: Evidence of alteration in one of the following forms: Higher chromas and redder hues than the underlying Removal of carbonates, either partially (Bmk) or completely (Bm). Illuviation, if evident, too slight to meet the requirements of a Bt or a podzolic B. Some weatherable minerals. No cementation or induration and lacks a brittle consistence when moist. This suffix can be used as Bm, Bmgj, Bmk, and Bms.
n	A horizon in which the ratio of exchangeable Ca to exchangeable Na is 10 or less. It must also have the following distinctive morphological characteristics: prismatic or columnar structure, dark coatings on ped surfaces, and hard to very hard consistence when dry. It is used with B, as Bn or Bnt.
p	A horizon disturbed by man's activities, such as cultivation, logging, habitation, etc. It is used with A and O.
S	A horizon with salts, including gypsum, which may be detected as crystals or veins, as surface crusts of salt crystals, by depressed crop growth, or by the presence of salt-tolerant plants. It is commonly used with C and k (Csk), but can be used with any horizon or combination of horizon and lowercase suffix.

sa	A horizon with secondary enrichment of salts more soluble than calcium and magnesium carbonates, in which the concentration of salts exceeds that present in the unenriched parent material. The horizon is 10 cm or more thick. The conductivity of the saturation extract must be at least 4 ms/cm and must exceed that of the C horizon by at least one-third.
t	An illuvial horizon enriched with silicate clay. It is used with B alone (Bt), with B and g (Btg), with B and n (Bnt), etc.
Bt	 A Bt horizon is one that contains illuvial layer lattice clays. It forms below an eluvial horizon, but may occur at the surface of a soil that has been partially truncated. It usually has a higher ratio of fine clay to total clay than IC. It has the following properties: If any part of an eluvial horizon remains and there is no lithologic discontinuity between it and the Bt horizon, the Bt horizon contains more total and fine clay than the eluvial horizons, as follows: If any part of the eluvial horizon has less than 15% total clay in the fine earth fraction (2 mm), the Bt horizon must contain at least 3% more clay, e.g., Ae 10% clay, Bt minimum 13% clay. If the eluvial horizon has more than 15% and less than 40% total clay in the fine earth fraction, the ratio of the clay in the Bt horizon to that in the eluvial horizon must be 1.2 or more, e.g., 20% clay increase in the Bt over Ae. If the eluvial horizon has more than 40% total clay in the fine earth fraction, the Bt horizon must contain at least 8% more clay than the eluvial horizon, e.g., Ae 50% clay, Bt at least 58% clay. A Bt horizon must be at least 5 cm thick. In some sandy soils where clay accumulation occurs in the lamellae, the total thickness of the lamellae should be more than 10 cm in the upper 150 cm of the profile. In massive soils the Bt horizon should have oriented clays in some pores and also as bridges between the sand grains. If peds are present, a Bt horizon shows clay skins on some of the vertical and horizontal ped surfaces and in the fine pores, or shows oriented clays in 1% or more of the cross section, as viewed in thin section. If a soil shows a lithologic discontinuity between the eluvial horizon and the Bt horizon, or if only a plow layer overlies the Bt horizon, the Bt horizon need show only clay skins in some part, either in some fine pores or on some vertical and horizontal ped surfaces. Thin sections should show that some part of the horizon has ab
Btj	Btj and Btg are defined under j and g.
u	A horizon that is markedly disrupted by physical or faunal processes other than cryoturbation. Evidence of marked disruption such as the inclusion of material from other horizons, absence of the horizon, etc., must be evident in at least half of the cross section of the pedon. Such turbation can result from blowdown of trees, mass movement of soil on slopes, and burrowing animals. It can be used with any horizon or subhorizon with the exception of A or B alone; e.g., Aeu, Bfu, BCu.

X	A horizon of fragipan character. A fragipan is a loamy subsurface horizon of high bulk density and very low organic matter content. When dry, it has a hard
	consistence and seems to be cemented. When moist, it has moderate to weak
	brittleness. It frequently has bleached fracture planes and is overlain by a friable
	B horizon. Air dry clods of fragic horizons slake in water.
у	A horizon affected by cryoturbation as manifested by disrupted and broken
	horizons, incorporation of materials from other horizons, and mechanical sorting
	in at least half of the cross section of the pedon. It is used with A, B, and C alone or in combination with other subscripts, e.g., Ahy, Ahgy, Bmy, Cy, Cgy,
	Cygj, etc.
z	A frozen layer. It may be used with any horizon or layer, e.g., Ohz, Bmz, Cz,
	Wz.

7.3.3 Unit of Measurement

The measurement units for the parameters contained in the data files on the CD-ROM are:

Column Name	Units
SITE NAME	[none]
SUB SITE	[none]
MEASUREMENT YEAR	[unitless]
PIT	[none]
HORIZON	[none]
START DEPTH	[meters]
END_DEPTH	[meters]
DRY_SOIL_COLOR	[none]
STRUCTURE_DESCR	[none]
SOIL_PH	[PH]
BULK_DENSITY	[kilograms][meter^-3]
PEAT_DESCR	[none]
TOTAL_SOIL_C_CONTENT	[percent]
SOIL_ORG_C_CONTENT	[percent]
SOIL_INORG_C_CONTENT	[percent]
ELECTRIC_CONDUCTIVITY	[siemens][meter^-1]
CATION_EX_CAPACITY	<pre>[millimoles +ve charge][kilograms^-1 of soil]</pre>
EXCHANGE_SODIUM	<pre>[millimoles +ve charge][kilograms^-1 of soil]</pre>
EXCHANGE_POTASSIUM	<pre>[millimoles +ve charge][kilograms^-1 of soil]</pre>
EXCHANGE_CALCIUM	<pre>[millimoles +ve charge][kilograms^-1 of soil]</pre>
EXCHANGE_MAGNESIUM	<pre>[millimoles +ve charge][kilograms^-1 of soil]</pre>
EXCHANGE_HYDROGEN	<pre>[millimoles +ve charge][kilograms^-1 of soil]</pre>
WATER_CONTENT_10KPA	[percent]
WATER_CONTENT_33KPA	[percent]
WATER_CONTENT_1500KPA	[percent]
SOIL_NITROGEN_CONTENT	[percent by weight]
SOIL_PHOSPHORUS_CONTENT	[percent by weight]
VERY_COARSE_SAND	[percent]
COARSE_SAND	[percent]
MEDIUM_SAND	[percent]
FINE_SAND	[percent]
VERY_FINE_SAND	[percent]
TOTAL_SAND	[percent]

TOTAL_SILT [percent]
TOTAL_CLAY [percent]
SOIL_TEXTURE [none]
CRTFCN_CODE [none]
REVISION_DATE [DD-MON-YY]

7.3.4 Data Source

The sources of the parameter values contained in the data files on the CD-ROM are:

Column Name	Data Source			
SITE_NAME	[Assigned by BORIS]			
SUB_SITE	[Assigned by BORIS]			
MEASUREMENT_YEAR	[Supplied by Investigator]			
PIT	[Supplied by Investigator]			
HORIZON	[Supplied by Investigator]			
START_DEPTH	[Supplied by Investigator]			
END_DEPTH	[Supplied by Investigator]			
DRY_SOIL_COLOR	[Supplied by Investigator]			
STRUCTURE_DESCR	[Supplied by Investigator]			
SOIL_PH	[Supplied by Investigator]			
BULK_DENSITY	[Supplied by Investigator]			
PEAT_DESCR	[Supplied by Investigator]			
TOTAL_SOIL_C_CONTENT	[Supplied by Investigator]			
SOIL_ORG_C_CONTENT	[Supplied by Investigator]			
SOIL_INORG_C_CONTENT	[Supplied by Investigator]			
ELECTRIC_CONDUCTIVITY	[Supplied by Investigator]			
CATION_EX_CAPACITY	[Supplied by Investigator]			
EXCHANGE_SODIUM	[Supplied by Investigator]			
EXCHANGE_POTASSIUM	[Supplied by Investigator]			
EXCHANGE_CALCIUM	[Supplied by Investigator]			
EXCHANGE_MAGNESIUM	[Supplied by Investigator]			
EXCHANGE_HYDROGEN	[Supplied by Investigator]			
WATER_CONTENT_10KPA	[Supplied by Investigator]			
WATER_CONTENT_33KPA	[Supplied by Investigator]			
WATER_CONTENT_1500KPA	[Supplied by Investigator]			
SOIL_NITROGEN_CONTENT	[Supplied by Investigator]			
SOIL_PHOSPHORUS_CONTENT	[Supplied by Investigator]			
VERY_COARSE_SAND	[Supplied by Investigator]			
COARSE_SAND	[Supplied by Investigator]			
MEDIUM_SAND	[Supplied by Investigator]			
FINE_SAND	[Supplied by Investigator]			
VERY_FINE_SAND	[Supplied by Investigator]			
TOTAL_SAND	[Supplied by Investigator]			
TOTAL_SILT	[Supplied by Investigator]			
TOTAL_CLAY	[Supplied by Investigator]			
SOIL_TEXTURE	[Supplied by Investigator]			
CRTFCN_CODE	[Assigned by BORIS]			
REVISION_DATE	[Assigned by BORIS]			

7.3.5 Data Range The following table gives information about the parameter values found in the data files on the CD-ROM.

	Minimum	Maximum	Missng	Unrel	Below	Data
	Data	Data	Data	Data	Detect	Not
Column Name	Value 	Value	Value	Value	Limit	Cllctd
SITE_NAME	SSA-90A-FLXTR	SSA-YJP-FLXTR	None	None	None	None
SUB_SITE	9TE01-SOL01	9TE01-SOL34	None	None	None	None
MEASUREMENT_YEAR	1994	1994	None	None	None	None
PIT	1	5	None	None	None	None
HORIZON	AB	peat	None	None	None	None
START_DEPTH	15	3	None	None	None	None
END_DEPTH	-0.1	4.1	-9.99	None	None	None
DRY_SOIL_COLOR	10YR4/2	n/a	None	None	None	None
STRUCTURE_DESCR	N/A	N/A	None	None	None	None
SOIL_PH	3.4	9.2	None	None	None	None
BULK_DENSITY	70	1790	-999	None	None	None
PEAT_DESCR	N/A	N/A	None	None	None	None
TOTAL_SOIL_C_CONTENT	.02	51.69	None	None	None	None
SOIL_ORG_C_CONTENT	.01	49.13	None	None	None	None
SOIL_INORG_C_CONTENT	0	12.66	None	None	None	None
ELECTRIC_	0	124.7	-999	None	None	None
CONDUCTIVITY						
CATION_EX_CAPACITY	8.4	1196.2	-999	None	None	None
EXCHANGE_SODIUM	.1	4.3	-999	None	None	None
EXCHANGE_POTASSIUM	.3	82.8	-999	None	None	None
EXCHANGE_CALCIUM	2.9	1374.7	-999	None	None	None
EXCHANGE_MAGNESIUM	. 2	262.4	-999	None	None	None
EXCHANGE_HYDROGEN	0	483.9	-999	None	None	None
WATER_CONTENT_10KPA	1.36	34.24	-999	None	None	None
WATER_CONTENT_33KPA	.96	27.37	-999	None	None	None
WATER_CONTENT_	.43	15.66	-999	None	None	None
1500KPA						
SOIL_NITROGEN_	0	2.241	None	None	None	None
CONTENT						
SOIL_PHOSPHORUS_	0	.195	None	None	None	None
CONTENT						
VERY_COARSE_SAND	.11	39.17	-999	None	None	None
COARSE_SAND	.53	68.94	-999	None	None	None
MEDIUM_SAND	.63	53.59	-999	None	None	None
FINE_SAND	3.8	63.95	-999	None	None	None
VERY_FINE_SAND	.43	34.76	-999	None	None	None
TOTAL_SAND	21	98.62	-999	None	None	None
TOTAL_SILT	.49	58.94	-999	None	None	None
TOTAL_CLAY	.81	29.41	-999	None	None	None
SOIL_TEXTURE	N/A	N/A	None	None	None	None
CRTFCN_CODE	CPI	CPI	None	None	None	None
REVISION_DATE	22-OCT-96	22-OCT-96	None	None	None	None

Minimum Data Value -- The minimum value found in the column.

Maximum Data Value -- The maximum value found in the column.

Missng Data Value -- The value that indicates missing data. This is used to indicate that an attempt was made to determine the

parameter value, but the attempt was unsuccessful. Unrel Data Value -- The value that indicates unreliable data. This is used to indicate an attempt was made to determine the parameter value, but the value was deemed to be unreliable by the analysis personnel. Below Detect Limit -- The value that indicates parameter values below the instruments detection limits. This is used to indicate that an attempt was made to determine the parameter value, but the analysis personnel determined that the parameter value was below the detection limit of the instrumentation. Data Not Cllctd -- This value indicates that no attempt was made to determine the parameter value. This usually indicates that BORIS combined several similar but not identical data sets into the same data base table but this particular science team did not measure that parameter. Blank -- Indicates that blank spaces are used to denote that type of value.

N/A -- Indicates that the value is not applicable to the respective column.

None -- Indicates that no values of that sort were found in the column.

7.4 Sample Data Record

The following are wrapped versions of data record from a sample data file on the CD-ROM.

```
SITE NAME, SUB SITE, MEASUREMENT YEAR, PIT, HORIZON, START DEPTH, END DEPTH,
DRY_SOIL_COLOR,STRUCTURE_DESCR,SOIL_PH,BULK_DENSITY,PEAT_DESCR,
TOTAL_SOIL_C_CONTENT, SOIL_ORG_C_CONTENT, SOIL_INORG_C_CONTENT,
ELECTRIC_CONDUCTIVITY, CATION_EX_CAPACITY, EXCHANGE_SODIUM, EXCHANGE_POTASSIUM,
EXCHANGE CALCIUM, EXCHANGE MAGNESIUM, EXCHANGE HYDROGEN, WATER CONTENT 10KPA,
WATER_CONTENT_33KPA, WATER_CONTENT_1500KPA, SOIL_NITROGEN_CONTENT,
SOIL PHOSPHORUS CONTENT, VERY COARSE SAND, COARSE SAND, MEDIUM SAND, FINE SAND,
VERY_FINE_SAND,TOTAL_SAND,TOTAL_SILT,TOTAL_CLAY,SOIL_TEXTURE,CRTFCN_CODE,
REVISION DATE
'SSA-90A-FLXTR', '9TE01-SOL01', '1993', '1', 'L', -.08, -.06, 'n/a',
'weakly decomposed leaf material',6.7,110,'N/A',44.24,43.81,.43,60.2,1018.4,
1.3, 27.1, 1323.1, 204.9, 320.5, -999.0, -999.0, -999.0, 2.194, .14, -999.0, -999.0, -999.0,
-999.0,-999.0,-999.0,-999.0,'N/A','CPI',22-OCT-96
'SSA-90A-FLXTR','9TE01-SOL01','1993','1','F',-.06,-.03,'n/a',
'moderately decomposed leaf material',6.7,230,'N/A',40.19,39.74,.45,52.01,1101.9,
1.5,34.4,1050.5,192.3,363.3,-999.0,-999.0,-999.0,2.125,.174,-999.0,-999.0,-999.0,
-999.0,-999.0,-99 9.0,-999.0,-999.0,'N/A','CPI',22-OCT-96
```

8. Data Organization

8.1 Data Granularity

The smallest amount of data that can be ordered from this data set is the entire data set from all soil pits at the SSA sites.

8.2 Data Format(s)

The Compact Disk-Read-Only Memory (CD-ROM) files contain ASCII numerical and character fields of varying length separated by commas. The character fields are enclosed with single apostrophe

marks. There are no spaces between the fields.

Each data file on the CD-ROM has four header lines of Hyper-Text Markup Language (HTML) code at the top. When viewed with a Web browser, this code displays header information (data set title, location, date, acknowledgments, etc.) and a series of HTML links to associated data files and related data sets. Line 5 of each data file is a list of the column names, and line 6 and following lines contain the actual data.

9. Data Manipulations

9.1 Formulae

All relevant data manipulation information can be obtained in the manuals and references listed Section 17 or described in Section 5. These standard measurements used the standard manipulations.

9.1.1 Derivation Techniques and Algorithms

None given.

9.2 Data Processing Sequence

None given.

9.2.1 Processing Steps

None given.

9.2.2 Processing Changes

None.

9.3 Calculations

9.3.1 Special Corrections/Adjustments

None.

9.3.2 Calculated Variables

None given.

9.4 Graphs and Plots

None.

10. Errors

10.1 Sources of Error

Much of the errors incurred would be due to the heterogeneity of soils and to equipment precision. These errors associated with measuring these soil properties are within the limits required for the use of these data.

10.2 Quality Assessment

The soil survey was performed by a soil expert who has many years of soil survey field experience. As a result, there is a great deal of confidence in the field visual observations and in the quality of soil samples brought into the lab for analysis. All methods for measuring soil characteristics have been performed routinely in the department's soil survey division. All methods have been tested thoroughly for accuracy, accepted for the general soil survey of Saskatchewan, and approved at the federal research level.

10.2.1 Data Validation by Source

A cursory review of the data was made to ensure that the data were as expected. Some spot checks were made to confirm that the data were within the realm of possibility.

10.2.2 Confidence Level/Accuracy Judgment

None given.

10.2.3 Measurement Error for Parameters

The error ranges for some of the parameters are:

- pH: 5%
- Bulk Density: 5%
- TC and IC: 3%
- Total Nitrogen and Phosphorus: 5%
- EC and CEC: 5%
- Exchangeable H+: 10%
- Soil Moisture Retentions (0.1, 0.33, and 15 atm): 5%
- Particle Size Fractions: 5%

10.2.4 Additional Quality Assessments

None.

10.2.5 Data Verification by Data Center

The data were checked after loading into the relational data base to ensure that no errors occurred during loading.

11. Notes

11.1 Limitations of the Data

None given.

11.2 Known Problems with the Data

None given.

11.3 Usage Guidance

None given.

11.4 Other Relevant Information

None.

12. Application of the Data Set

This data set was collected to provide major soil parameter data for modeling and other research purposes for the BOREAS project.

13. Future Modifications and Plans

None.

14. Software

14.1 Software Description

None.

14.2 Software Access

None.

15. Data Access

The SSA soil lab data are available from the Earth Observing System Data and Information System (EOSDIS) Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC).

15.1 Contact Information

For BOREAS data and documentation please contact:

ORNL DAAC User Services Oak Ridge National Laboratory P.O. Box 2008 MS-6407 Oak Ridge, TN 37831-6407

Phone: (423) 241-3952 Fax: (423) 574-4665

E-mail: ornldaac@ornl.gov or ornl@eos.nasa.gov

15.2 Data Center Identification

Earth Observing System Data and Information System (EOSDIS) Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC) for Biogeochemical Dynamics http://www-eosdis.ornl.gov/.

15.3 Procedures for Obtaining Data

Users may obtain data directly through the ORNL DAAC online search and order system [http://www-eosdis.ornl.gov/] and the anonymous FTP site [ftp://www-eosdis.ornl.gov/data/] or by contacting User Services by electronic mail, telephone, fax, letter, or personal visit using the contact information in Section 15.1.

15.4 Data Center Status/Plans

The ORNL DAAC is the primary source for BOREAS field measurement, image, GIS, and hardcopy data products. The BOREAS CD-ROM and data referenced or listed in inventories on the CD-ROM are available from the ORNL DAAC.

16. Output Products and Availability

16.1 Tape Products

None.

16.2 Film Products

None.

16.3 Other Products

These data are available on the BOREAS CD-ROM series.

17. References

17.1 Platform/Sensor/Instrument/Data Processing Documentation

Manual on Soil Sampling and Methods of Analysis. 1978. J.A. MckKeague (Ed). Canadian Soil Science Society.

Technicon Industrial Systems. 1973. Nitrate and nitrite in water and waste water. Industrial Method No. 100-70W. Technicon Industrial Systems, Tarrytown, NY.

17.2 Journal Articles and Study Reports

Murphy, J. and J.P. Riley. 1962. A modified single solution method for determination of phosphate in natural waters. Anal. Chim. Acta. 27: 31-36.

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17.3 Archive/DBMS Usage Documentation

None.

18. Glossary of Terms

None.

19. List of Acronyms

AEAC - Albers Equal-Area Conic

ASCII - American Standard Code for Information Interchange

BOREAS - BOReal Ecosystem-Atmosphere Study

BORIS - BOREAS Information System CD-ROM - Compact Disk-Read-Only Memory

CEC - Cation Exchange Capacity

DAAC - Distributed Active Archive Center

EC - Electric Conductivity
EOS - Earth Observing System

EOSDIS - EOS Data and Information System GIS - Geographic Information System GSFC - Goddard Space Flight Center HTML - HyperText Markup Language

- Inorganic Carbon - Modeling Sub-Area IC MSA

NAD83 - North American Datum of 1983

NASA - National Aeronautics and Space Administration NIST - National Institute of Standards and Technology

NSA - Northern Study Area

OA - Old Aspen

OBS - Old Black Spruce - Organic Carbon OC OJP - Old Jack Pine

ORNL - Oak Ridge National Laboratory PANP - Prince Albert National Park ΡI - Principal Investigator

SSA - Southern Study Area

TC - Total Carbon

- Terrestrial Ecology TE

TE - Terrestrial Ecology
TGB - Trace Gas Biogeochemistry
URL - Uniform Resource Locator

- Young Aspen ΥA YJP - Young Jack Pine

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13. ABSTRACT (Maximum 200 words)

This data set was collected by TE-1 to provide a set of soil properties for BOREAS investigators in the SSA. The soil samples were collected at sets of soil pits in 1993 and 1994. Each set of soil pits was in the vicinity of one of the five flux towers in the BOREAS SSA. The collected soil samples were sent to a lab, where the major soil properties were determined. These properties include, but are not limited to, soil horizon; dry soil color; pH; bulk density; total, organic, and inorganic carbon; electric conductivity; cation exchange capacity; exchangeable sodium, potassium, calcium, magnesium, and hydrogen; water content at 0.01, 0.033, and 1.5 MPascals; nitrogen; phosphorus; particle size distribution; texture; pH of the mineral soil and of the organic soil; extractable acid; and sulfur. The data are stored in tabular ASCII text files.

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